A319/A320/A321
TECHNICAL TRAINING MANUAL
SA Family to A319/A320/A321 PW1100G - T1+T2
30-ICE AND RAIN PROTECTION

This document must be used for training purposes only.

Under no circumstances should this document be used as a reference.

It will not be updated.


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ENGINE AIR INTAKE ICE PROTECTION SYSTEM PRESENTATION

USERS

The Nacelle Anti-Ice (NAI) System is designed to prevent ice formation on the engine inlet which could affect the engine operation. The engine air intake is heated during icing conditions using its related bleed air. The hot air is then discharged overboard.

SOURCE

Hot air for the Nacelle anti-ice system is supplied by a dedicated HP Compressor (HPC) bleed:

- on the CFM-LEAP, 7th stage,
- on the PW1000G, 6th stage.

VALVE

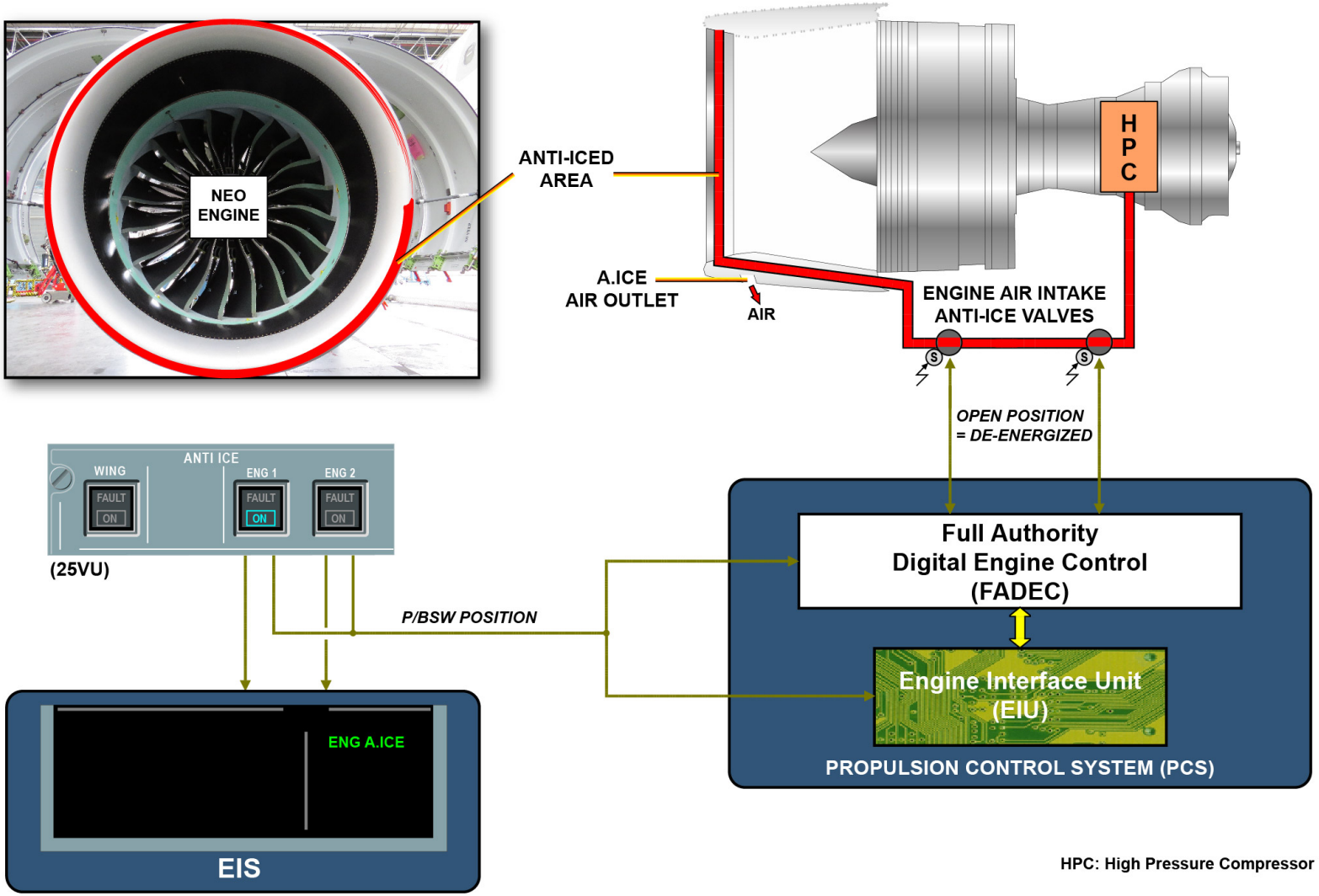
The NAI System is controlled and monitored by the Propulsion Control System (PCS) (EEC and EIU). Each engine NAI System consists of two electrically controlled, pneumatically operated Pressure Regulating and Shut-Off Valves (PRSOV).
The EEC energizes the solenoid to CLOSE the PRSOV. Therefore, in case of loss of electrical power supply, the valves will go fully open provided the engine bleed air supply pressure is high enough. In the absence of air pressure, the valve is spring-loaded to the closed position.

CONTROLS

When the ENG ANTI ICE P/BSW is selected ON, signals are sent to EEC for controlling the valves and to the EIU to calculate the bleed decrements.

ECAM PAGE

If at least one of the two engine air intake anti-ice protection systems is selected ON, a message appears in green on the upper ECAM right MEMO. The EEC monitors the valve position through transducers and processes them to generate necessary indications and warning through the Flight Warning System (FWS). The FAULT indication in the PB S/W is activated by the PCS.



USERS ... ECAM PAGE

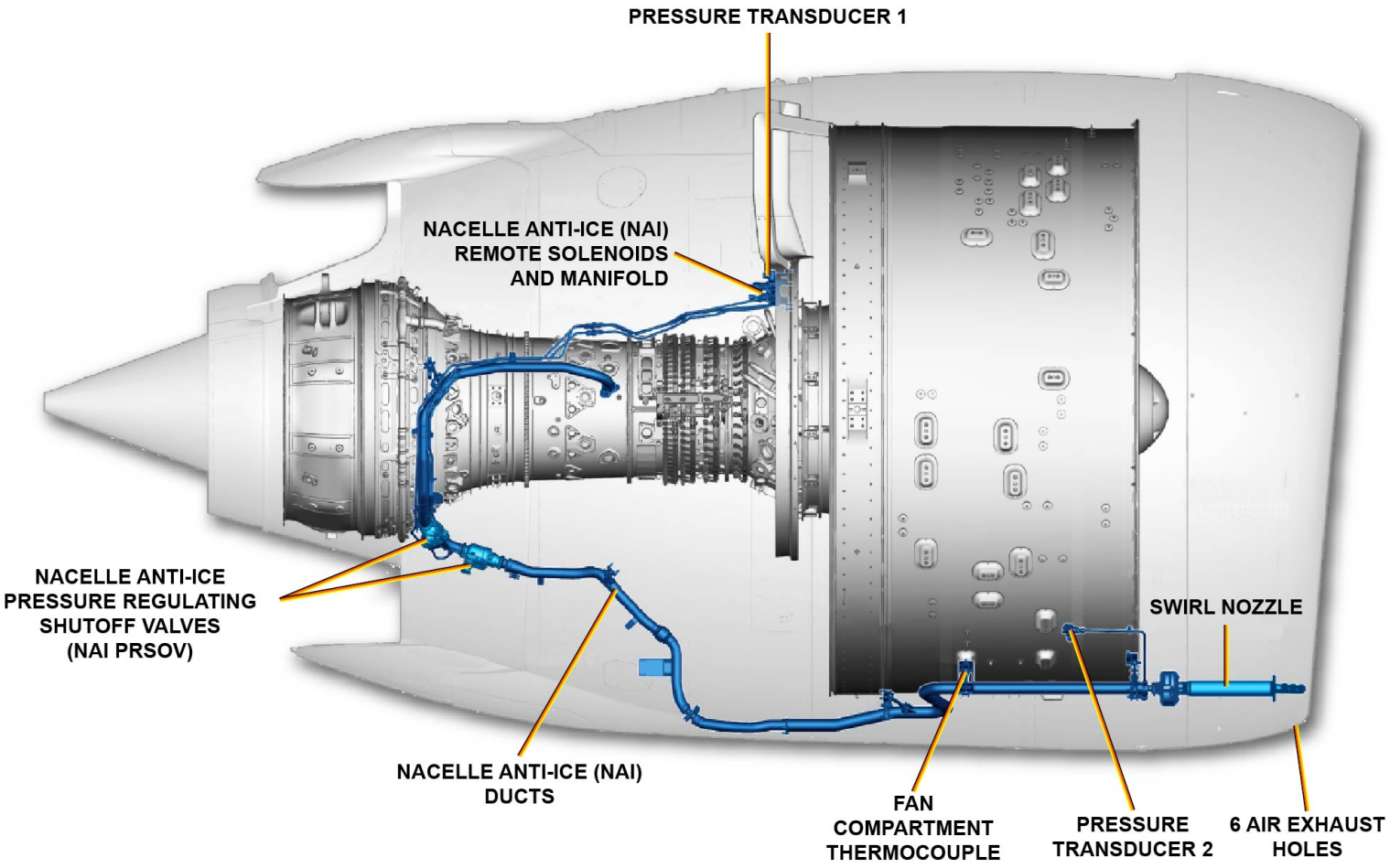
ENGINE AIR INTAKE ICE PROTECTION SYSTEM DESCRIPTION

NAI SYSTEM

Each engine air intake has its own independent Nacelle Anti-Ice (NAI) protection system.
NAI System uses the hot bleed air from a dedicated engine bleed port (6th stage High Pressure Compressor (HPC) for PW1100G).
This bleed air is lead to engine air inlet through a feed duct which passes along the RH side of the engine core and fan case.
Each engine NAI system consists of one command P/B SW but two Pressure Regulating and Shut -Off Valves (PRSOVs) for good operability, two
P
ressure Transducers (PTs), temperature protection and supply ducts.
Both PRSOVs are located on the engine core, Right Hand (RH) side.

AIR INLET COWL

The air is released into the air intake lip (D-Duct) through a swirl system which mixes the air and injects it in a specific pattern for effective heating.
The airflow exits the air intake lip by a single exhaust grid at the bottom of the nacelle outside the fan which has 6 oval holes.



PW1100G

NAI SYSTEM - AIR INLET COWL

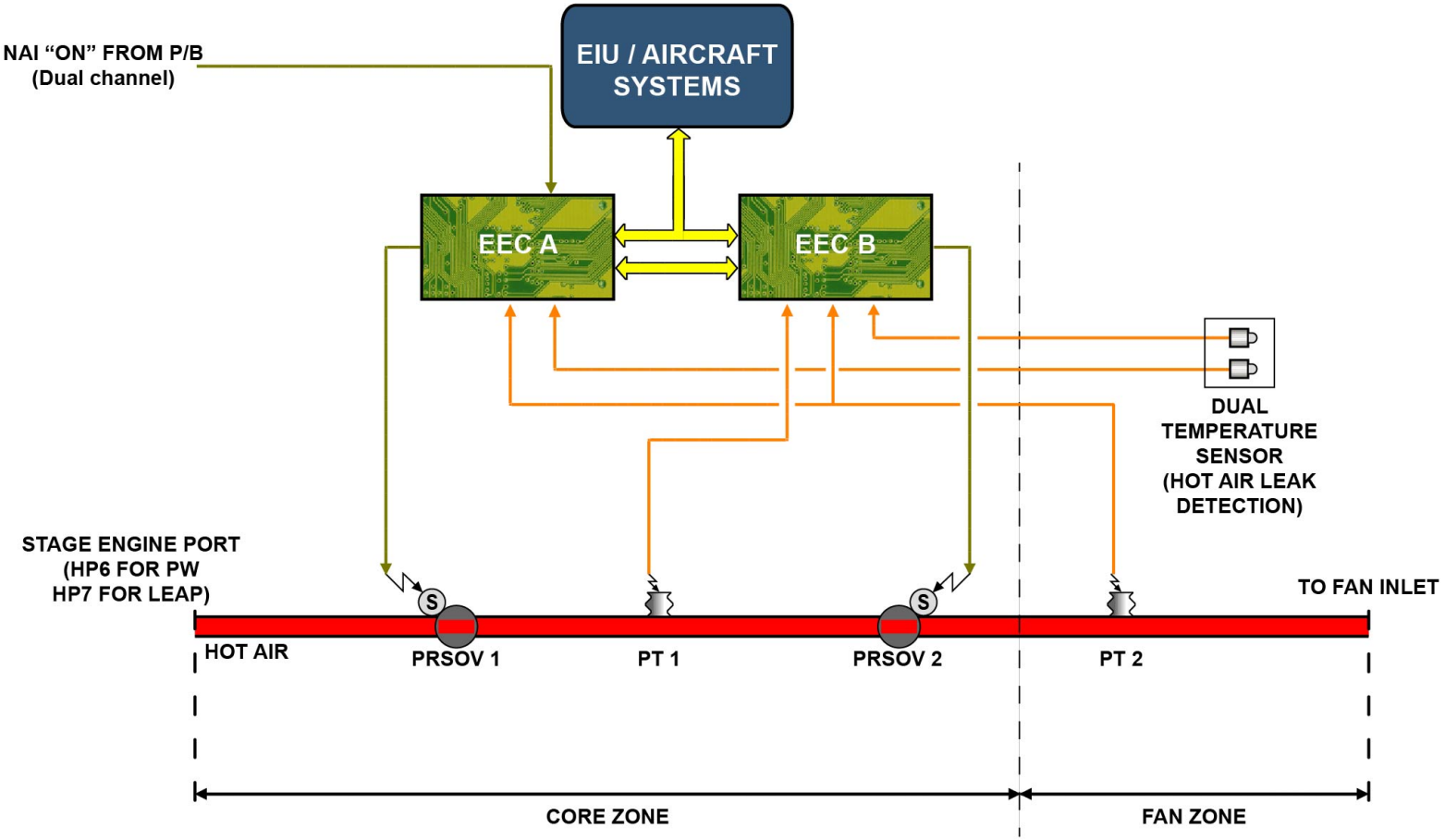
ENGINE AIR INTAKE ICE PROTECTION SYSTEM DESCRIPTION

PRSOV CONTROL AND OPERATION

The NAI system is controlled and monitored by the Propulsion Control System (PCS) (Engine Electronic Controller (EEC) and Engine Interface Unit (EIU)).The EEC controls the PRSOV operation by energizing/de-energizing the solenoids. PRSOV 1 is controlled by EEC Channel A and PRSOV 2 is controlled by Channel B. Each PRSOV pneumatically regulates the downstream air pressure.
When the NAI PB S/W is selected to 'ON' position, the EEC de-energizes the solenoid valves of PRSOV to OPEN the valves. Only when both the valves are open the bleed air is fed to the engine intake lip.
The PRSOV 1 regulates the upstream pressure then in cascade PRSOV 2 the downstream pressure at different threshold.

MONITORING

The EEC does a detailed monitoring of the PRSOVs with two PTs (PT1 & PT2) located downstream each PRSOV.
PT1 is located in between the PRSOVs in the core engine area. It gives the feedback to channel B only and use for trouble shooting.
PT2 is located downstream of PRSOV 2 in the fan case. It gives the feedback to both the EEC channels for monitoring function in case of single failure of EEC channel.
A dual temperature sensor located in the fan case, provides the EEC (one per channel) with the fan compartment temperature measurement for NAI leakage detection.
When the engine is running and a "Hot Air Leakage" event is detected, the EEC energizes PRSOVs solenoids, which provide insulation function.



EEC: Engine Electronic Controller
EIU: Engine Interface Unit
NAI: Nacelle Anti-Ice
PRSOV: Pressure Regulating Shut-Off Valve
PT: Pressure Transducer

PRSOV CONTROL AND OPERATION - MONITORING

ENGINE AIR INTAKE ICE PROTECTION SYSTEM DESCRIPTION

ENGINE ANTI ICE P/BSW

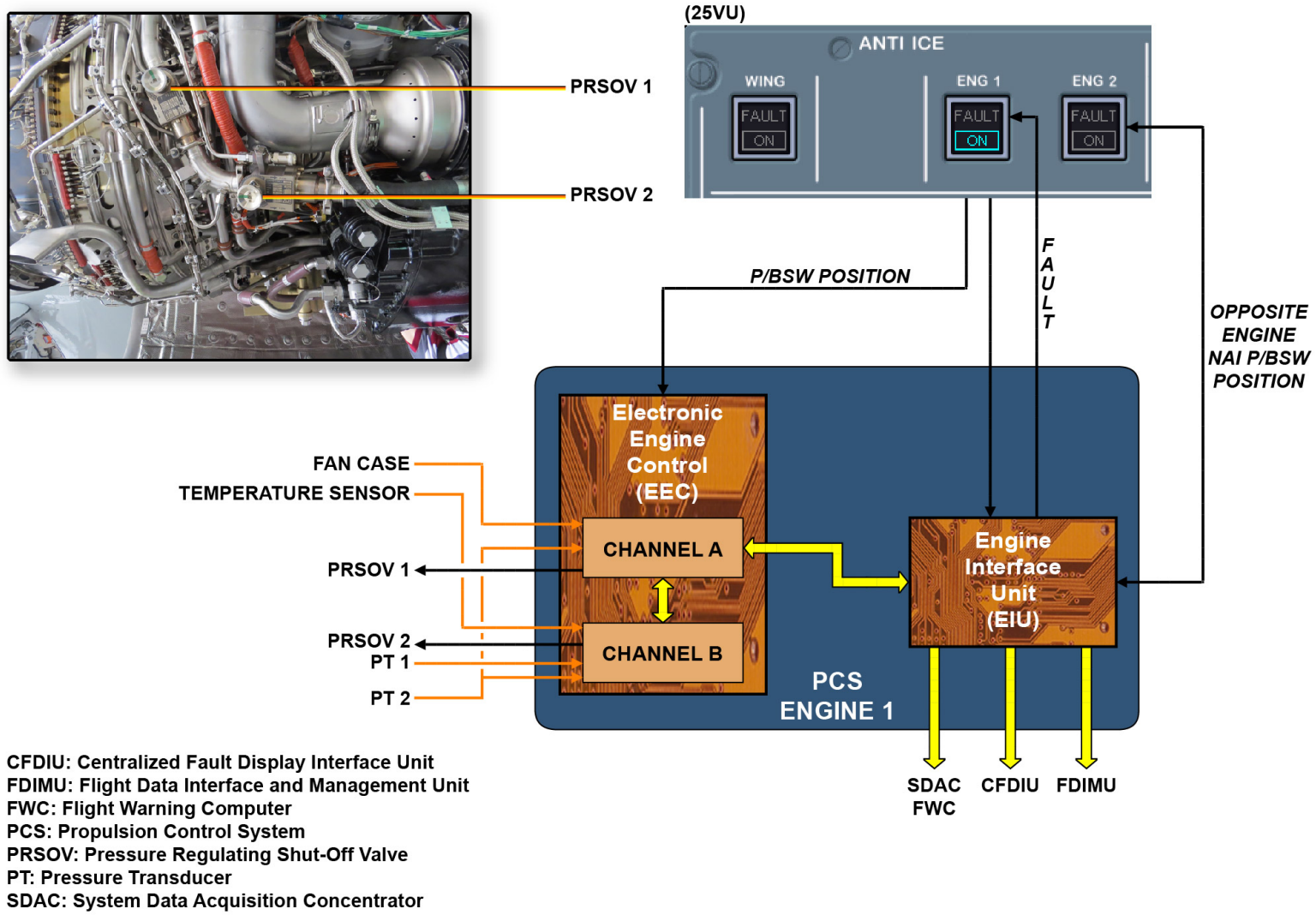
The P/B SW sends a discrete signal to the EEC to operate the PRSOVs.
The P/B SW position and the opposite engine P/B SW position are monitored by the EIU for computing the bleed decrements.
The "FAULT" light is triggered by the EIU based on the input from EEC. It appears when the engine is running and NAI is failed in OPEN or CLOSED. It also appears in case of monitoring fault.

PCS (EEC and EIU)

The EEC controls the PRSOV to open when the P/B SW is set to ON.
The EEC monitors the position of the PRSOV by the two NAI transducers to trigger associated fault messages.
The System Data Acquisition Concentrator/Flight Warning System (SDAC/FWS), Flight Data Interface and Management Unit (FDIMU) and Centralized Fault Display Interface Unit (CFDIU) interfaces with the PCS.

FAILURE CONDITION

The fail safe position of the valves in case of EEC dual channel failure is OPEN.
In case of a single valve failure, the corresponding valve being failed open, the anti-ice function is still available.
The two pressure Transducers (PT1 for core zone and PT2 for fan zone) monitors leak or burst scenarios and a dual fan case thermocouple helps in identifying over temperature conditions due to leaks or burst. The EEC monitors the same and generates warning messages to the FWS.
Master Minimum Equipment List (MMEL) IMPACT- In case of both NAI valve failures, dispatching with one of the two valves locked close will not be possible.



CFDIU: Centralized Fault Display Interface Unit
FDIMU: Flight Data Interface and Management Unit
FWC: Flight Warning Computer
PCS: Propulsion Control System
PRSOV: Pressure Regulating Shut-Off Valve
PT: Pressure Transducer
SDAC: System Data Acquisition Concentrator

ENGINE ANTI ICE P/BSW - PCS (EEC AND EIU) & FAILURE CONDITION

ICE AND RAIN PROTECTION SYSTEM LINE MAINTENANCE

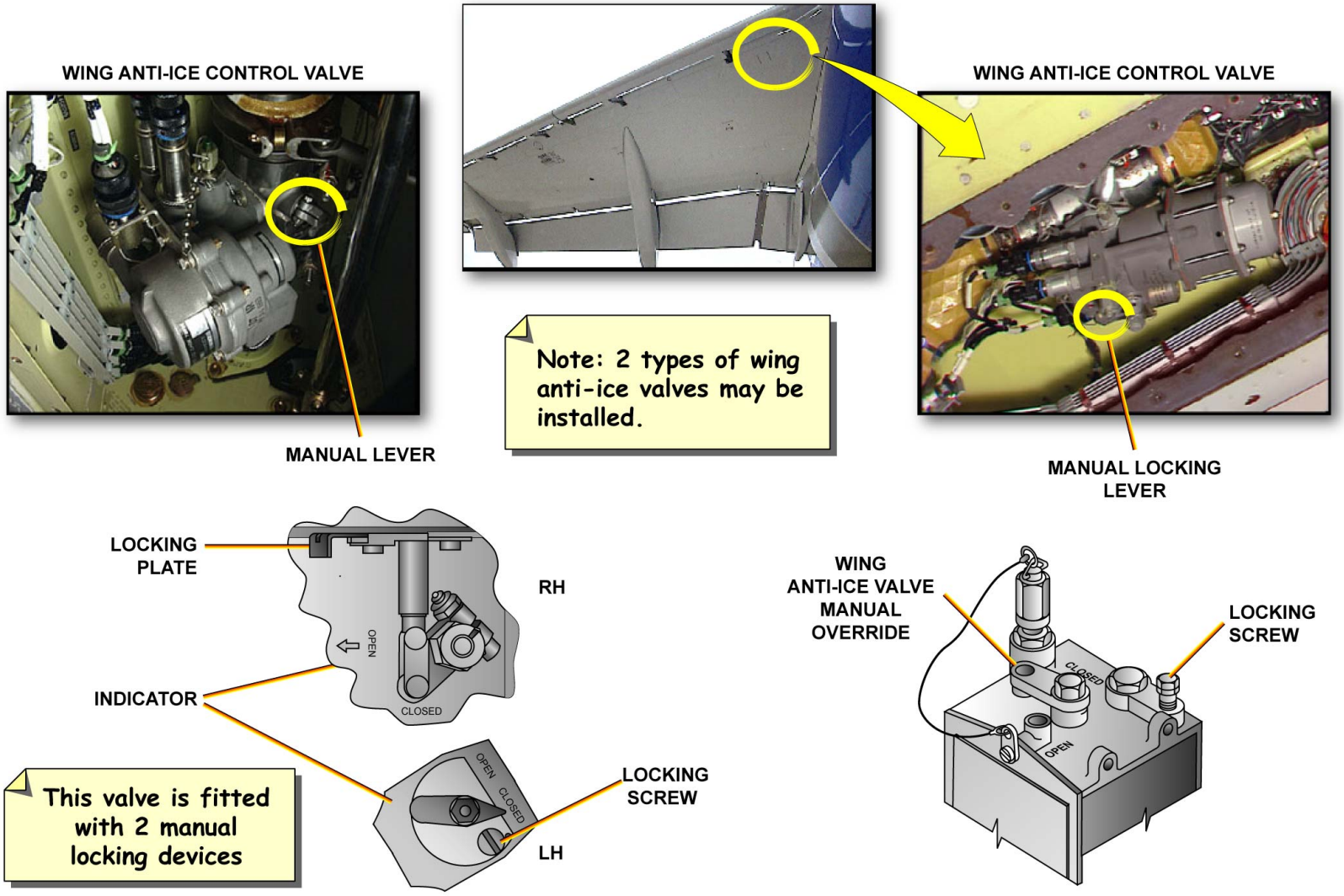
MEL/DEACTIVATION

WING ICE PROTECTION

In case of failure, the aircraft may be dispatched per Minimum Equipment List with the RH WING anti-ice valve deactivated in the OPEN position or either valve in the CLOSED position. If the valve is deactivated OPEN, the associated engine bleed switch must be selected OFF until after takeoff. A flight manual performance penalty is applied (fuel consumption is increased by 1%). If the valve is deactivated CLOSED, the aircraft may not be flown into icing conditions.

Procedure:

- Install zero-locking tool on slat/flap lever to prevent movement,
- Depressurize bleed air system,
- Remove access panel on wing lower surface,
- Move the valve indicator to the required position and install the locking screw OR,
- Move the valve indicator to the required position and install the locking plate.



MEL/DEACTIVATION - WING ICE PROTECTION

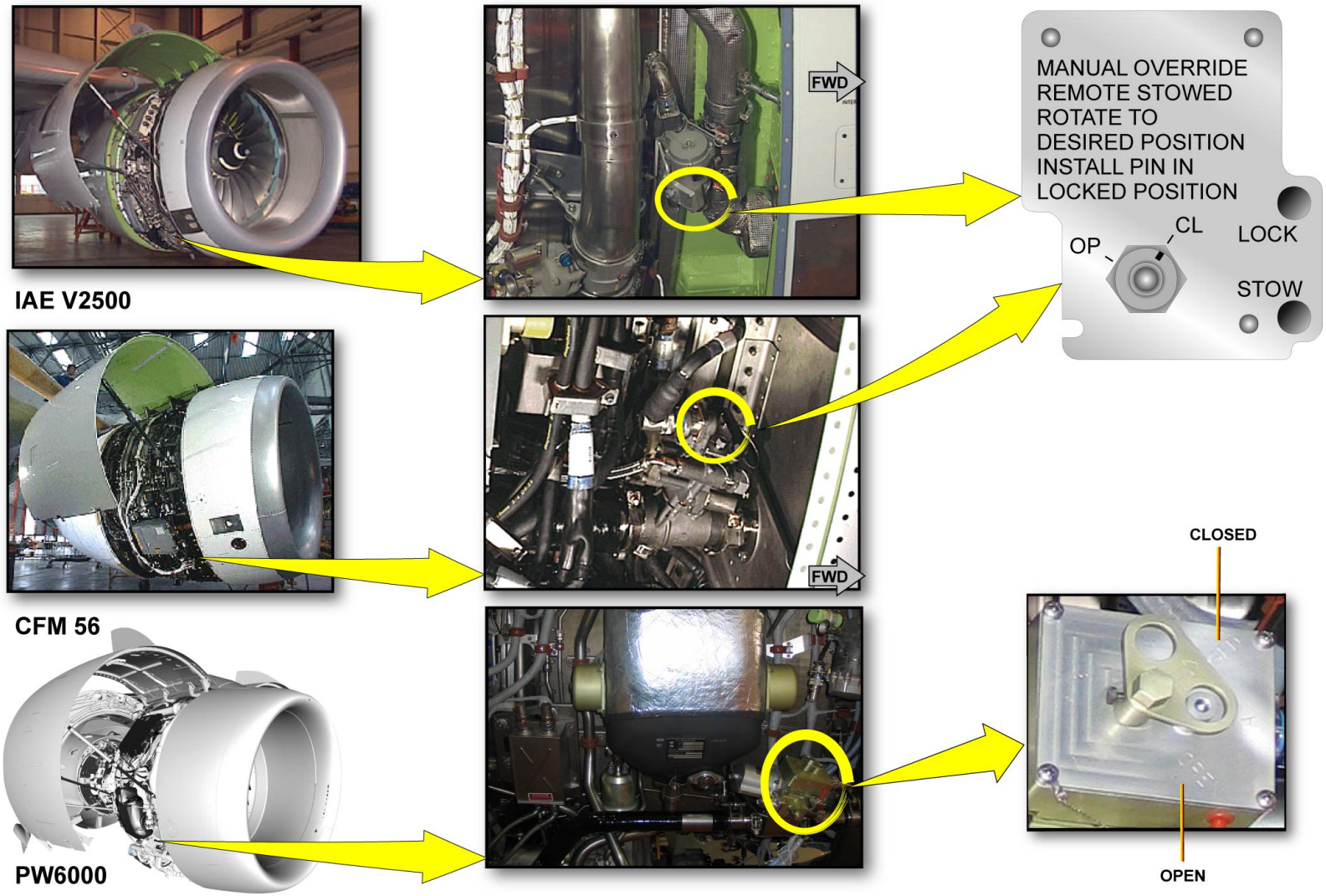
ICE AND RAIN PROTECTION SYSTEM LINE MAINTENANCE

MEL/DEACTIVATION (continued)

ENGINE AIR INTAKE ICE PROTECTION - CEO

In case of failure, the aircraft may be dispatched per Minimum Equipment List with one ENGINE anti-ice valve deactivated in the OPEN or CLOSED position. If the valve is deactivated OPEN, a Flight Manual performance penalty must be applied. Based on temperature and altitude, the maximum weight, takeoff speeds and fuel consumption will be adjusted. If the valve is deactivated CLOSED, the aircraft may not be flown into icing conditions.
Procedure:
- Full Authority Digital Engine Control (FADEC) ground power OFF,
- open RH fan cowl,
- move the manual override to the required position.

Lock in place with the locking pin, for CFM and V2500 engines. For PW6000 engines, the air intake anti-ice valve is locked manually with the locking lever in the OPEN position or the CLOSED position.



MEL/DEACTIVATION - ENGINE AIR INTAKE ICE PROTECTION - CEO

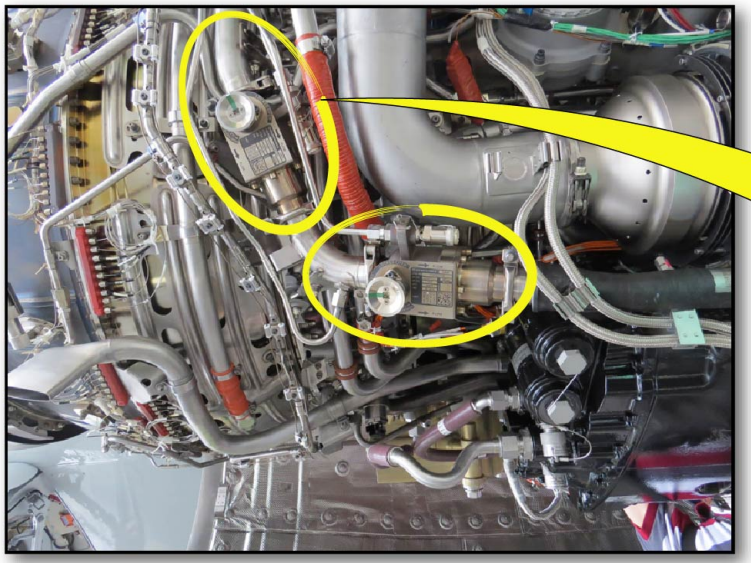
ICE AND RAIN PROTECTION SYSTEM LINE MAINTENANCE

MEL/DEACTIVATION (continued)

ENGINE AIR INTAKE ICE PROTECTION - NEO PW

The Engine Air Intake Valve is controlled and monitored by the Engine Electronic Control (EEC).
In case of failure, the Aircraft may be dispatched as per Master Minimum Equipment List (MMEL) with one ENGINE anti-ice valve deactivated in the OPEN position through the Manual Override mechanism on the Pressure Regulating Shut-Off Valve (PRSOV).

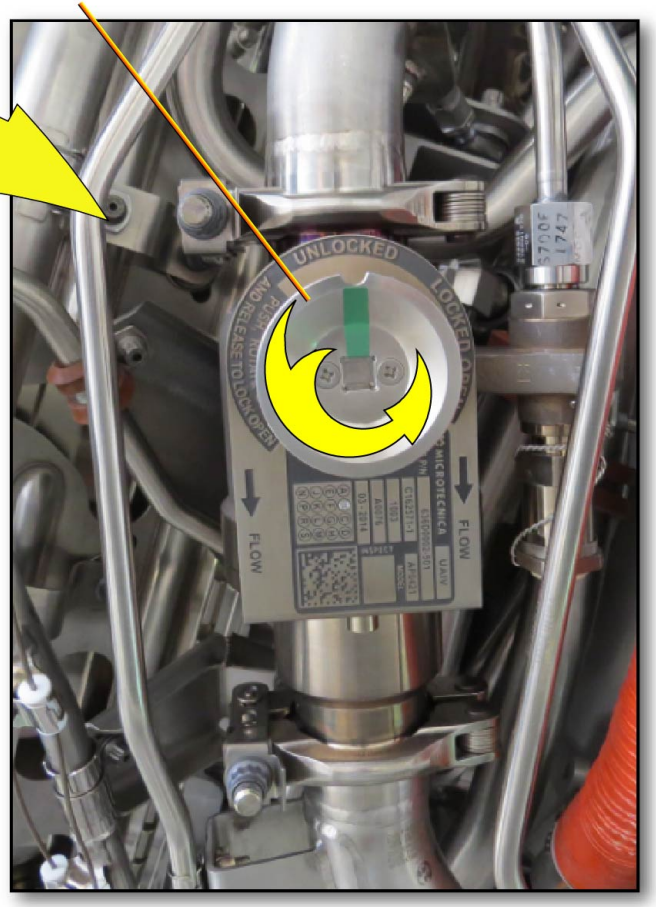
NOTE: Dispatch with 2 PRSOVs locked in open position is not allowed for air inlet stress reason.
No PRSOV can be set in locked closed position.



PRESSURE REGULATING SHUT OFF VALVES
(PRSOVs)

ACCESS WITH REVERSER COWLS CLOSED

PRSOV MANUAL
OVERRIDE MECHANISM



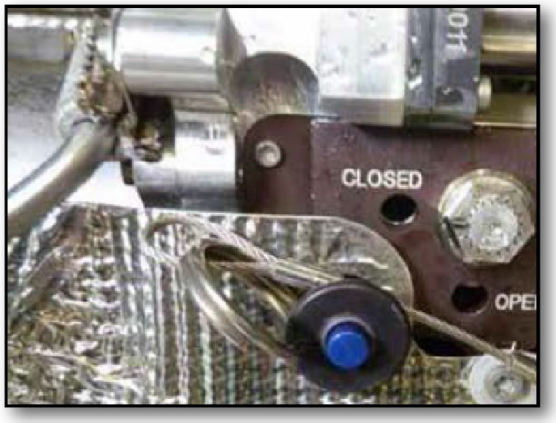
MEL/DEACTIVATION - ENGINE AIR INTAKE ICE PROTECTION - NEO PW

ICE AND RAIN PROTECTION SYSTEM LINE MAINTENANCE

MEL/DEACTIVATION (continued)

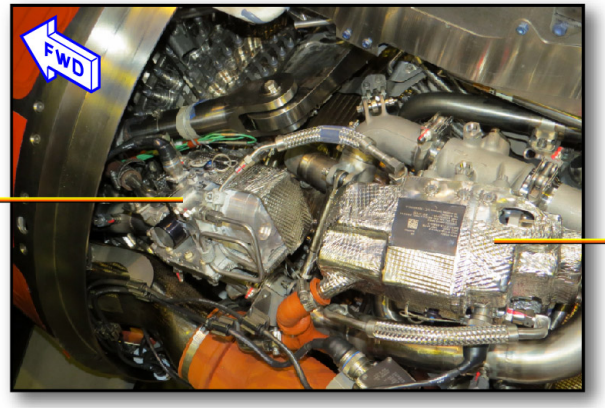
ENGINE AIR INTAKE ICE PROTECTION - NEO CFM LEAP

The Engine Air Intake Anti-ice system is controlled and monitored by the Propulsion Control System (PCS).
In case of failure, the Aircraft may be dispatched as per Master Minimum Equipment List (MMEL) with one ENGINE anti-ice valve deactivated in the OPEN position through the Manual Override mechanism on the valve itself or via the EEC CFDS Special Functions menu.
This function has protection to avoid having both Nacelle Anti-Ice (NAI) valves locked in the open position: overpressure risk.
One or 2 PRSOVs can be set in locked closed position and the Aircraft not operated in Icing conditions, no ETOPS conducted.

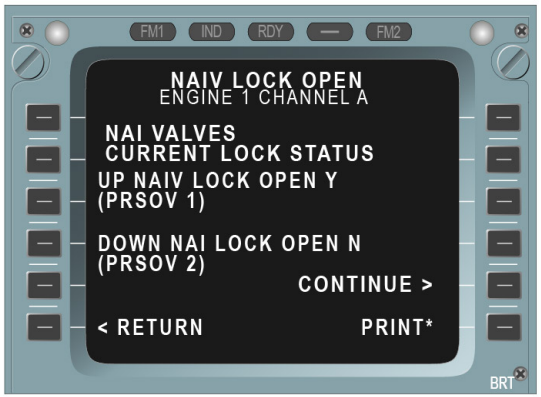


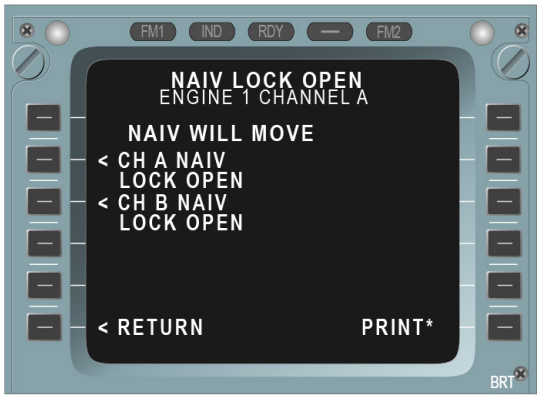
OR

PRSOV: Pressure Regulating Shut-Off Valve



EEC CFDS
The NAI Lock Open Function provides the ability to lock the NAI valves to their open positions or to unlock NAI valves from their open positions.





MEL/DEACTIVATION - ENGINE AIR INTAKE ICE PROTECTION - NEO CFM LEAP

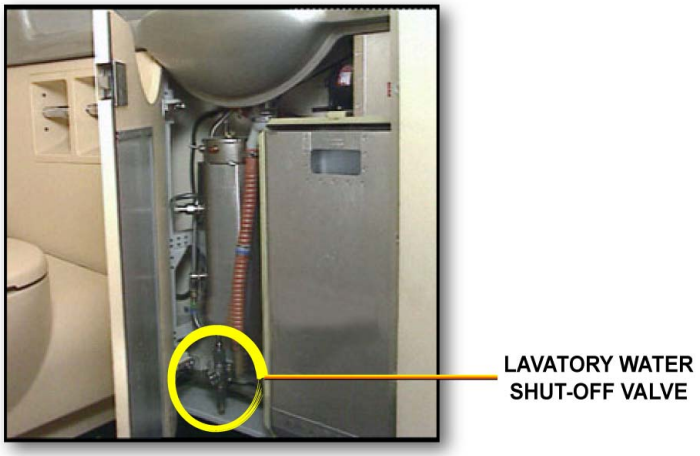
ICE AND RAIN PROTECTION SYSTEM LINE MAINTENANCE

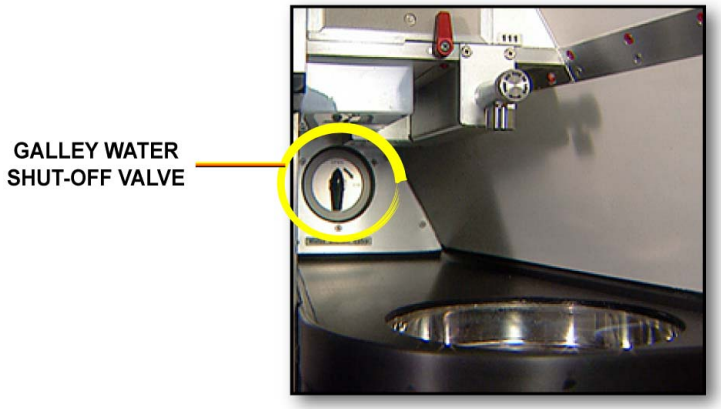
MEL/DEACTIVATION (continued)

DRAIN MAST ICE PROTECTION

In case of a failure of a drain mast heater, the fault will be displayed on the Flight Attendant Panel (FAP) of the Cabin Intercommunication Data System (CIDS). The aircraft may be dispatched per Minimum Equipment List with the drain mast heater inoperative. The water supply to the LAVatory(ies) (LAV(s)) and galley which use the failed drain mast must be shut off. As a result, the LAV(s) will not be usable and must be secured closed and locked.

FLIGHT ATTENDANT PANEL (FAP)



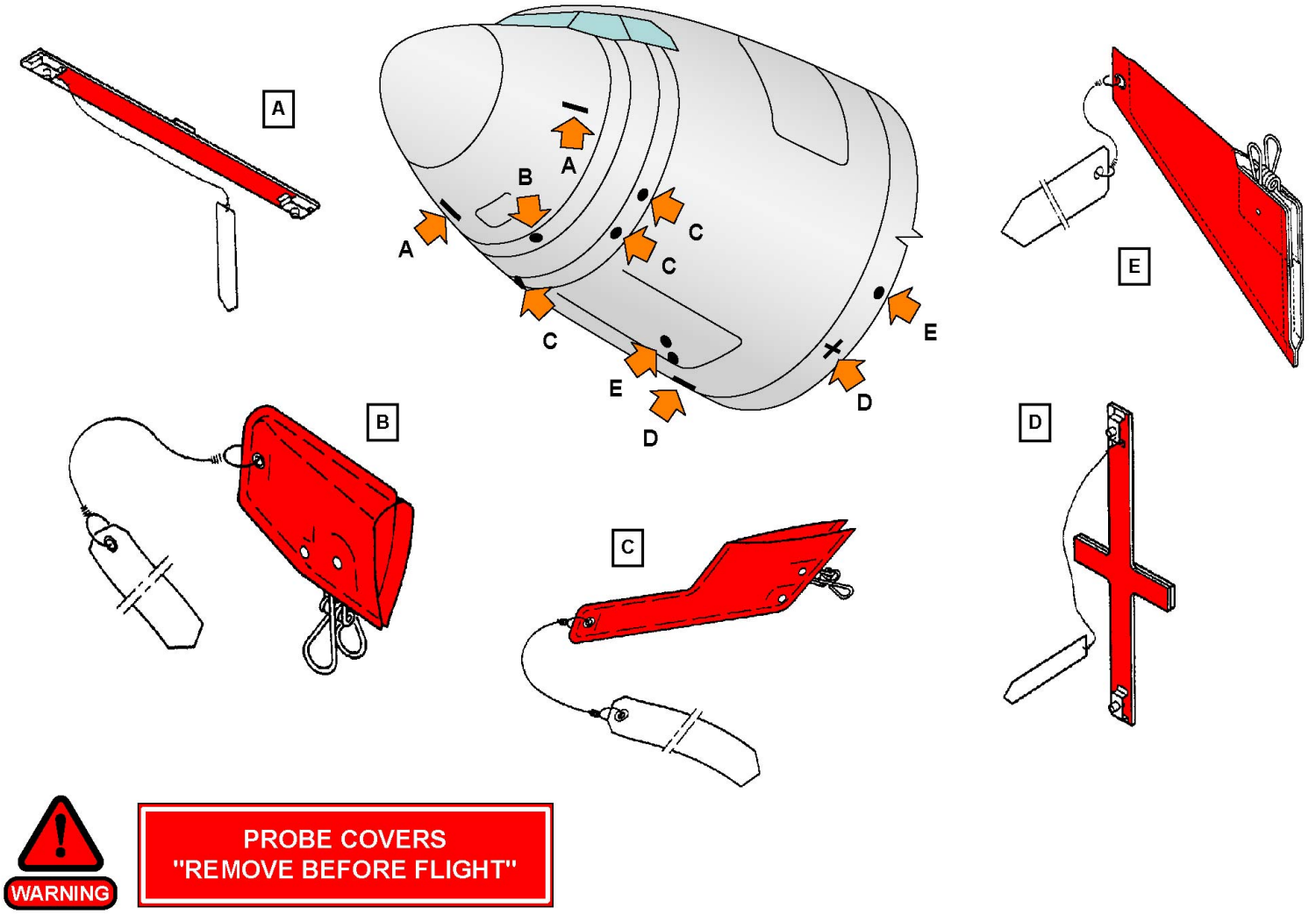


MEL/DEACTIVATION - DRAIN MAST ICE PROTECTION

ICE AND RAIN PROTECTION SYSTEM LINE MAINTENANCE

MAINTENANCE TIPS

When the aircraft is parked, it is recommended to install protective covers on the air data probes (static ports, pitot probes, AOA probes, TAT probes). The protective covers help protect the probes from contamination. The covers should be marked with REMOVE BEFORE FLIGHT. Ground personnel must insure that the covers are removed before flight or before power is applied to the probes (engine start or ground test).
The probe heat system operates automatically to power the air data probe heaters when at least one engine is running. It is also designed to operate automatically when the aircraft is in flight. During the troubleshooting and the on ground operations, observe the following precautions:
- if the Probe Heat Computer (PHC) power supply C/B is pulled, the PHC internal relay will relax and the related probes will be heated. Make sure to pull ALL of the associated probe heat C/B's (Static supply (28VDC), AOA supply, Pitot supply & TAT supply (all 115 VAC)).
- if the Engine Interface Unit (EIU) power supply C/B is pulled, the PHC will sense an "engine running" condition and the probes will be heated. Make sure to pull ALL of the probe heat C/B's (Static supply (28VDC), AOA supply, Pitot supply & TAT supply (all 115 VAC)).
- if the C/B of the LGCIU is pulled, it simulates FLIGHT situation. So the probe heating is also switched ON.



MAINTENANCE TIPS